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mens were obtained early in June 1902, and are issued simultaneously in Ohio F., No. 75.

The technical description of the proposed species is as follows:

Rhytisma concavum Ell. & Kellerm. n. sp. — Stromata epiphyllous but also visible below, forming thin, black, thickly scattered blotches, 1-4 mm. diameter, orbicular or subangular, the surface uneven, surrounded by a pale yellowish, narrow margin, more or less concave below and the margin broader and paler, at maturity rupturing by radiating fissures, in the oblong forms a central elongated fissure also occuring and in the larger ones a circular area being cut out, the hygroscopic lobes strongly recurved when moist exposing a light yellowish, later sordid yellow then blackish disk. Asci 80-110 x 8-10 $\mu$, oblanceolate, much elongated below, strongly acute at the apex, accompanied by abundant slender and at the tips. Spores 20-35 x 2-3 $\mu$ hyaline, nearly straight to strongly elongated mostly flexuous paraphyses about 4 $\mu$ wide, usually enlarged curved, slightly thicker at one end in which are large clear granules.

On leaves of Ilex verticillata; spores mature in June. Type specimen in Herb. W. A. Kellerman.

# CULTURES OF UREDINEAE IN 1900 AND 1901

BY J. C. ARTHUR.

The first especially important cultures of plant rusts made by the writer were conducted in 1899, and the results published in the Botanical Gazette for April 1900 (29:268-276). During the two following years only a small number of cultures were made, and for a number of reasons the results have not been put into type until now. This article is, therefore, the second of the series.

The method pursued in most cases in making the cultures has been stated in the preceding article. It was, in brief, to remove spores with a knife from the host, and place them on a dampened plant which it is desired to infect. The plants are grown in pots. After the spores are sown the whole plant is covered with a belljar and kept shaded for a day, or sometimes two days. The plants are then uncovered and placed on a greenhouse bench, where they remain until the period of observation is ended.

In 1900 the only cultures made that require mention were with Euphorbia rust. The results supplement and confirm those made in 1899 (Bot. Gaz. 29:270-271). It was again found that spores from Euphorbia nutans would grow upon the same species, but not upon E. maculata. It seems quite probable that this rust, Uromyces euphorbiae C. & P. possesses specialized forms. The record is as follows:

July 21, Aecidiospores from Euphorbia nutans sown on E. nutans; July 30, uredo.

July 21, Aecidiospores from E. nutans sown on E. maculata; no infection.

July 21, Uredospores from E. nutans sown on E. nutans; July 31, uredo.

July 21, Uredospores from E. nutans sown on E. maculata; no infection.

There are two ways in which the right species of plant may be selected on which to make a sowing of a heterœcious rust. One is to sow upon any species known to harbor an aecidium, hoping after making a smaller or larger number of tests to hit upon the right one. This method in my own work has led to very meagre results, so slight, in fact, as scarcely to be worth the trouble. During 1901 the following rusts were tried in this blind way, all being very common forms in this vicinity, only to ascertain that wrong plants were selected for the sowings or else the spores did not gain entrance possibly through defective treatment.

Puccinia emaculata Schw. on Panicum capillare was sown twice on Onagra biennis, with no infection.

Puccinia caricina DC. A form of this aggregate on Carex tetanica was sown on Erigeron annuus and Onagra biennis, with no infection.

Puccinia atkinsoniana Diet. on Carex lurida. The name of this species was unknown at the time the cultures were made, but through the kindness of Professor Atkinson, it has since been compared with type material and its status definitely settled. It was sown on Aster cordifolius, Aster paniculatus, Solidago serotina, Xanthium canadense, Ambrosia trifida, Impatiens aurea and Ribes cynosbati, with no infection.

Puccinia peckii (DeT.) Kellerm. on Carex trichocarpa. The names of both host and rust were unknown at the time the cultures were made. The host has since been found in fruit, and the rust has been successfully grown by Professor Kellerman and also the writer, as recorded in the preceding number of this Journal (8:20). Spores were sown on Aster cordifolius, Aster paniculatus, Solidago serotina, Solidago canadensis, Ribes cynosbati, Erigeron annuus, and Eupatorium perfoliatum, with no infection.

Puccinia rubigo-vera DC. A form of this aggregate of Bromus ciliatus was sown on Hepatica acuta and Viola cucullata, with no infection.

During 1901 the culture of seven species was successfully carried out. Three of these were in confirmation of previous work, as follows:

Puccinia caricis (Schum.) Reb. April 25, teleutospores from Carex stricta were sown on Urtica gracilis; May 2, spermogonia appeared, and May 5, æcidia.

Puccinia angustata Pk. May 3, teleutospores from Scirpus atrovirens were sown on Lycopus americanus; May 11, Spermogonia appeared, and May 20, aecidia.

Puccinia poculiformis (Jacq.) Wettst. May 2, teleutospores from Cinna arundinacea were sown on Berberis vulgaris; May 13, spermogonia appeared, and May 22, aecidia.

Of the remaining four species, all Carex rusts, the clues which led to successful cultures were obtained in the field, and have been mentioned and explained in an article in the Botanical Gazette for January of the present year. For three of these species it seems necessary to propose new names. All are yet insufficiently studied to determine their exact boundaries.

### PUCCINIA ALBIPERIDIA sp. nov.

O. Spermogonia amphigenous, small, pale orange.

I. Aecidia hypophyllous, small in circular clusters; substratum scarcely thickened; peridia white, low, margin incised, reflexed; spores pale yellow when fresh, subglobose, 15-20 μ in diameter; wall thin, smooth.

II. Uredosori hypophyllous, small, round or oblong, soon naked; uredospores oblong, small, echinulate.

III. Teleutosori hypophyllous, globose or oblong, pulvinate, dark brown. Teleutospores oblong-cuneate, 17-24 by 32-45 μ; apex semicircular or obtuse, thickened to half the length of the upper cell; side walls thin, slightly or not constricted; pedicel slender, colored, as long as the spore or shorter.

On Ribes cynosbati L. grown June, 1901 from teleutospores collected on Carex pubescens Muhl, Lafayette, Ind., April 30, 1901.

This species is characterized by the white or nearly white aecidia, which may be called Aecidium albiperidium. They are in marked contrast with the deep orange aecidia that are so abundant throughout North America on various species of Ribes. The only field collection known to the writer is one on Ribes gracile made at Decorah, Iowa, by E. W. D. Holway on June 2, 1901. When dry and faded the two forms of aecidia are much alike. Cultures were made as follows:

May 16, teleutospores from Carex pubescens sown on Aster paniculatus; no infection.

May —, teleutospores from Carex pubescens sown on Ribes cynosbati; May 30, spermogonia; June 9, aecidia.

### PUCCINIA CARICIS-ERIGERONTIS sp. nov.

O. Spermogonia epiphyllous, prominent, golden yellow.

I. Aecidia hypophyllous, in circular clusters; substratum slightly thickened; peridia short, much divided and recurved; aecidiospores yellow when fresh, isodiametric, 12-15 μ in diameter, wall thin, minutely tuberculate.

II. Uredosori hypophyllous, small, oblong, tardily naked; uredospores brownish-yellow when fresh, oval or obovate, small, 12-18 by 16-22 μ wall thin, thickly echinulate, pores 3 or 4 scattered.

III. Teleutosori hypophyllous, small, oblong, pulvinate, blackish brown, ruptured epidermis evident; teleutospores clavate or oblong-clavate, 14-20 by 35-42 μ; septum above the middle; apex obtuse or truncate, much thickened; side walls thin; pedicel firm; colored, one fourth or one half the length of the spore.

On Erigeron annuus (L.) Pers. and Carex festucacea Willd., Lafayette, Ind.

This species is without doubt the Caeoma (Aecidium) erigeronatum Schw. (Trans. Amer. Phil. Soc. 4:292), and probably occurs on many species of Erigeron throughout North America. Cultures were made as follows:

April 25, teleutospores from Carex festucacea sown on Erigeron annuus; May 2, spermogonia; May 11, aecidia.

April 25, teleutospores from C. festucacea sown on Taraxacum taraxacum; no infection.

### PUCCINIA CARICIS-ASTERIS sp. nov.

O. Spermogonia epiphyllous, yellow, punctiform, sunken in tissue of the leaf.

I. Aecidia hypophyllous, collected in groups on slightly swollen yellow or purplish spots, low, margin much divided and recurved; aecidiospores subglobose, 12-17 μ in diameter, wall thin, minutely roughened.

II. Uredosori hypophyllous, oblong; uredospores oblong or obovate, 12-16 by 18-22 μ; wall thin, echinulate; pores few, scattered.

III. Teleutosori hypophyllous, oblong to oblong-linear, prominent, soon naked, dark brown, ruptured epidermis noticeable; teleutospores oblong or clavate-oblong, 16-22 by 48-56 μ.; apex rounded, greatly thickened; pedicel slender, colored, half the length of the spore.

On Aster paniculatus Lam., Aster cordifolius L. and Carex foenea Willd. The latter collected at Decorah, Iowa, Dec. 30, 1900 by E. W. D. Holway, and at Lafayette, Ind., April 30, 1901, by the writer.

The common aecidium, found on many species of Aster, is probably included in this species, but not the aecidia found on Erigeron, Solidago or Geranium. It is the same as Aecidium asterum Schw. The uredospores and teleutospores are very similar to those of the preceding species, and are suggestive of biological species. Much work, however, must be done before an approximately accurate statement can be made regarding the Carex species having aecidia upon Compositae. Data for the present separation was obtained as follows:

April 25, teleutospores from Carex foenea (Iowa) sown on Erigeron annuus; no infection.

April 29, teleutospores from C. foenea (Iowa) sown on Erigeron annuus; no infection.

May 4, teleutospores from C. foenea (Indiana) sown on Aster paniculatus; May 13, spermogonia; May 22, aecidia.

May 4, teleutospores from C. foenea (Indiana) sown on Erigeron annuus; no infection.

May 11, teleutospores from C. foenea (Indiana) sown on Geranium maculatum; no infection.

May 11, teleutospores from C. foenea (Iowa) sown on Erigeron annuus; no infection.

May 13, teleutospores from C. foenea (Iowa) sown on Aster paniculatus; May 20, spermogonia; May 28, aecidia.

May 13, Teleutospores from C. foenea (Iowa) sown on Solidago canadensis; no infection.

May 13, teleutospores from C. foenea (Indiana) sown on Aster cordifolius; May 23, spermogonia; May 30, aecidia.

May 13, teleutospores from C. foenea (Indiana) sown on Solidago canadensis; no infection.

### PUCCINIA BOLLEYANA SACC.

This species is first mentioned in the Amer. Mo. Micr. Journal for 1889 (10:169), with an illustration but no description. It was first described in Saccardo's Sylloge (9:303), two years later. It was collected originally on a sterile sedge, presumably a Carex, growing from two to four feet high. The type locality is within two miles of Lafayette, Ind., and only an area ten or fifteen feet across supports the sedge, but almost every leaf over this area has been thickly covered with the rust each season since its discovery. Last year it was found in another locality about four miles distant. It has not been reported from any other place in this or other states, but a specimen sent from Kenosha county, Wisconsin, by Dr. J. J. Davis has proved to be this species. The species is especially characterized by the large teleutospores, and the brown, fusiform uredospores. Within the last month a fruiting specimen of the host has been found upon the type area, which shows it to be Carex trichocarpa Muhl. This in brief is the history of the rust up to the time of making the following cultures. Whether the aecidium, which has been found to grow on Sambucus canadensis, is the wide-spread Aecidium sambuci Schw., or not, it would be premature to say.

May 2, teleutospores from Carex trichocarpa sown on Sambucus canadensis; May 10, spermogonia; May 22, aecidia.

May 3, teleutospores from C. trichocarpa sown on Xanthium canadense; no infection.

May 3, teleutospores from C. trichocarpa sown on Impatiens aurea; no infection.

June 15, aecidiospores from Sambucus canadensis sown by Wm. Stuart on Carex trichocarpa; July 16, abundant uredospores first noticed, but probably not the first sori to appear.

### SUMMARY.

During 1900 and 1901 the life cycle of the following eight species of rusts was demonstrated by cultures. Of these successful cultures, the first four have been previously reported, while the cycle of the second four is here reported for the first time.

1. UROMYCES EUPHORBIA C. & P. and Aecidium euphorbiae Amer. Auct. with sowings of aecidiospores and uredospores.
2. PUCCINIA CARICIS (Schum.) Reb. and Aecidium urticae Schum. with sowings of teleutospores.
3. PUCCINIA ANGUSTATA Pk. and Aecidium lycopi Ger. with sowings of teleutospores.
4. PUCCINIA POCULIFORMIS (Jacq.) Wettst. and Aecidium berberidis Pers. with sowings of teleutospores.
5. PUCCINIA ALBIPERIDIA Arth. and Aecidium albiperidum Arth. with sowings of teleutospores.
6. PUCCINIA CARICIS-ERIGERONTIS Arth. and Aecidium erigeronatum Schw. with sowings of teleutospores.
7. PUCCINIA CARICIS-ASTERIS Arth. and Aecidium asterum Schw. with sowings of teleutospores.
8. PUCCINIA BOLLEYANA Sacc. and Aecidium sambuci Schw. (?) with sowings of teleutospores and aecidispores.

*Purdue University, Lafayette, Ind., June,* 1902.

## OHIO FUNGI. FASCICLE IV

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The following species are included:

61. Aecidium cimicifugatum Schw., on Cimicifuga racemosa (L.) Nutt.
62. Aecidium ranunculi Schw., on Ranunculus abortivus L.
63. Albugo candidus (Pers.) Kuntze, on Camelina sativa (L.) Crantz.
64. Cercospora althaeina Sacc., on Althaea rosea Cav. (cultivated).
65. Cercospora hydropiperis (Thuem.) Speg., on Polygonum punctatum Ell.
66. Cintractia junci (Schw.) Trel., on Juncus tenuis Willd.
67. Gymnoconia interstitialis (Schlecht.) Lagh., on Rubus occidentalis L.
68. Plasmopara halstedii (Farl.) Berl. & De Toni, on Vitis sp., cultivated.
69. Puccinia caricis (Schum.) Reb., on Urtica gracilis Ait.
70. Puccinia caricis (Schum.) Reb., on Carex stricta Lam.
71. Puccinia caricis (Schum.) Reb., on Carex riparia Curtis.
72. Puccinia mariae-wilsoni Clint., on Claytonia virginica L.
73. Puccinia taraxaci Plowright, on Taraxacum taraxacum (L.) Karst.
74. Puccinia taraxaci Plowright, on Taraxacum erythrospermum Andrz.
75. Rhytisma concavum Ell. & Kellerm., on Ilex verticillata (L.) Gray.
76. Rhytisma concavum Ell. & Kellerm., on Ilex verticillata (L.) Gray.
77. Septoria astericola E. & E., on Aster cordifolius L.
78. Septoria kalmiaecola (Schw.) B. & C., on Kalmia latifolia L.